

REGULATION AND REGISTRATION (IN CHAPTER 9: SAFETY AND REGULATION
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SAFETY AND REGULATION

INTRODUCTION

by Robert W. Brazelton¹ and Norman B. Akesson²

Most laws and regulations are developed to fill particular needs, and in cases involving a history of accidents or damage from pesticides, it is highly likely that an unfortunate type of incident or oversight leading to injury, especially when repeated numerous times, will result in regulatory action designed to eliminate the incidence of risk.

The overall extent of such laws and regulations is overwhelming, but this text will deal only with some most likely to concern weed-control personnel and associated management.

Origin and Relationships of Laws and Regulations

Within the governmental system, laws, regulations, ordinances, administrative rulings, and interpretations occur from the federal, state, and county levels down to ordinances of local governments. The requirements and effects can vary in detail and may sometimes even conflict with each other. The history of regulatory activities in California in recent years has shown that state regulations often are more comprehensive and restrictive than federal ones.

In the field of chemical weed control, pesticides in use are both subject to federal regulation and also closely monitored and controlled by the California Department of Food and Agriculture under which, not infrequently, controls are more restrictive or detailed than under federal ones. At the same time, regional, county, or local variations may exist to meet special problems.

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types and safe operational procedures other than pesticide regulations with which weed-control personnel should be acquainted. In fact, these should be so well implanted as to be "second nature" in the daily operations of both managers and workers.

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH

For over half a century, regulation of safety in industry has been in existence in California. The Division of Occupational Safety and Health (DOSH) developed the so-called 'Cal/OSHA' program. For many years this agency has based its regulatory functions on safety standards referred to in California as *safety orders*. Generally these safety orders relate to mechanical or electrical devices and related work procedures, but when chemicals are involved, the agency may join the Department of Food and Agriculture in enforcement in accordance with pre-established cooperative agreements. The legal implications of regulations may change from time to time, so the employer or private operator must be aware of responsibilities that apply and respond accordingly.

Safety Orders

The most basic safety order of significance to employers is a relatively recent one which is brief (only three sentences) and easy to understand. It provides the basis upon which weed-control operators can establish their safety programs. While the legal implications of this order may change as a result of regulatory or legislative interpretation, the concepts are basic to safe operations and can form the basis for any safety program. It simply reads:

ACCIDENT PREVENTION PROGRAM. Effective October 1, 1977, every employer shall inaugurate and maintain an accident-prevention program which shall include, but not be limited to the following:

- *A training program designed to instruct employees in general safe work practices and specific instructions with respect to hazards unique to the employee's job assignment.*
- *Scheduled periodic inspections to identify and correct unsafe conditions and work practices which may be found.*

This order involves both the machine and the worker. Machine safety is covered by the number of safety orders, and worker training is spelled out in others which will be discussed in more detail next.

Tractor Operation

The tractor accident is the most common cause of death in agricultural field operations. The hazard of severe injury has existed since tractors

first came into use. Investigations of thousands of tractor-related deaths and injuries over several decades have shown the majority to have been caused by violation of well-defined rules. Causes call for prevention, and extensive worldwide research proved conclusively that the single most effective form of protection would be the development of a satisfactory rollover-protection device for tractors similar to those which have been saving the lives of racing car drivers for years. That device called ROPS (rollover protective structure), combined with the use of a seatbelt to hold the operator in the "zone of safety," has been highly successful and is now required by law.

This history has led to the development of nine rules for tractor operation—one regarding ROPS and the other eight based on the major causes of accidents.

California Safety Orders and federal OSHA regulations require that the *employer* must train each new tractor driver (or spray-rig operator where a tractor is used) in these rules when the driver is hired and once per year thereafter.

These rules are:

1. Securely fasten your seatbelt if the tractor has a ROPS. (Many large field boom sprayers may be exempt from this rule by reason of their structures.)
2. Where possible, avoid operating the tractor near ditches, embankments, and holes.
3. Reduce speed when turning, crossing slopes, and on rough, slick, or muddy surfaces.
4. Stay off slopes too steep for safe operation.
5. Watch where you are going, especially at row ends, on roads, and around trees.
6. Do not permit others to ride on the tractor.
7. Operate the tractor smoothly—no jerky turns, starts, or stops.
8. Hitch only to the drawbar and hitch points recommended by the tractor manufacturer.
9. When tractor is stopped, set brakes securely and use park lock if available.

Forklifts

The handling of herbicides in quantity often involves the use of forklifts to lift pallet loads of containers. This is a specialized area, and the safe operation of forklifts is given rather special attention in California's safety orders, which are too lengthy to include here. Because the safety requirements related to forklifts are extensive, it is advisable that anyone responsible for such operations become well acquainted with these requirements.

Guarding

Spray equipment often involves the use of power-take-off shafts, gear drives, vee belts, or chain drives. Through the years these have been involved in many cases of laceration, amputation, and death. Therefore, the guarding of these drives has been a high priority in safety-order enforcement. Most commonly, home-built spray equipment will have a sheet metal guard below such a drive to keep it from entangling plant material, though the top, which is accessible to the operator, often may be open and unguarded. Regulations detailing requirements for guarding equipment because of the high degree of hazard involved are too extensive to be covered in detail here.

Very simply, the gist of the orders is that if a part rotates in transmitting power, it shall be completely enclosed and the guard itself, if made of material with openings such as expanded metal or grating, shall be spaced far enough away from the moving parts to protect fingers from contact. The wise manager will specify on purchase orders that the equipment being purchased should be designed and manufactured to meet safety standards. Or, if it is absolutely necessary to purchase equipment that does not meet safety standards when delivered, the employer would be wise to take steps to modify the equipment to bring it into conformance.

Power-take-off tractor drive shafts are particularly hazardous. Often these shafts are correctly supplied with free-rotating shield tubes but, upon installation, the connecting universal joints are unguarded. Loose clothing commonly comes in contact with such a part rotating at some 540 rpm and results can be disastrous. If the shaft itself is unguarded, the injury potential is substantially higher.

Electrical Hazards

Basically, all electrical equipment and wiring in weed-control operations must meet existing safety regulations, as well as local building-code requirements. Proper grounding and protection of wiring from physical damage is important, and selection of properly sized wiring to meet electrical load-carrying requirements is essential. Weed-control personnel normally may encounter the greatest hazard on field jobs working near high-voltage overhead power lines. Training should emphasize the motto "Look Up and Live."

Such power lines are often found along the edge of a field or running to irrigation pumping stations. The most common cause of electrocution in agriculture is raising aluminum irrigation pipe so that it touches the power line, or driving under a line with equipment such as a long spray boom raised vertically for transport.

Operators should be trained to avoid such contacts, and to realize

that, if they are on a mobile unit that makes such contact and they are initially unharmed, they are probably protected from grounding by the insulation provided by the unit's rubber tires. The best action in such a case is probably to remain in the safe position until rescued, or, if they attempt to get off, to make certain that neither they nor the machine touch the ground with any part. If they jump off, the jump should be completely clear, not touching any part and not allowing anyone to come in contact with the machine until the power company has shut off power and given the word that it can be moved safely.

NOTE: This overhead-power-line hazard has led to one of the most severe enforcement policies. Not maintaining 10 or more feet of clearance between upraised equipment and the power line is not only contrary to safety orders, but may also involve criminal charges under the Labor Code. Every employer and employee should be well informed of the requirements.

Employee Exposure and Medical Records

Regulations provide for employee access to personal medical records and exposure cards. The complexity of applying these regulations in practice is a matter which the employer should investigate thoroughly and perhaps request assistance in interpreting.

CHEMICAL DRIFT AND ITS CONTROL

The safety aspects of chemical drift have long presented problems in weed-control operations. These problems have ranged from damaged roses in the garden adjacent to a vacant lot where city workers applied a herbicide, to major losses and consequent lawsuits due to the drift of herbicides onto grape vineyards, cotton fields, and prune orchards. Some of these cases have been severe enough to cause serious financial damage to those involved or to lead to the banning or severe restriction of the use of the particular herbicide.

Drift-control Factors

Given that the safety of an operation may be impaired by numerous factors, among which may be the production of undesirable drift, a few practical application rules should be noted. The possibility of drift may be related to:

- type of application equipment and the droplet size produced
- chemical formulation
- microclimate
- size of area to be treated
- the operator's technique and skill.

Drift

When spray applications are made, the larger spray droplets of perhaps 100–200 microns in diameter and larger fall below the applicator (aircraft or ground sprayer) or may be carried a short distance downwind as swath displacement. The smaller droplets (under 100 microns), however, may be carried downwind great distances before reaching the ground, or lofted upward and carried even greater distances. If such a cloud of tiny droplets remains concentrated enough upon reaching the ground, economic damage may be done to the crop on which it descends. Such a situation is normally found when there is severe temperature inversion and little wind velocity. On the other hand, if air-mixing and lofting of the material to higher altitudes occur, it is entirely possible that the particles will be sufficiently scattered and degraded to pose no economic hazard. Drift may involve:

Tiny droplets: These can be carried in the air and deposited as noted above to cause damage.

Vapor: Volatile herbicides, once deposited, may volatilize and the vapor may cause damage to downwind sensitive crops on contact; or the vapor may collect on dust or plant particles in the air and thus be transported in the air.

Crystals and dust: Once a herbicide is in place on the target crop and the ground beneath the crop, the material may adhere to dust particles or the water may just evaporate to leave tiny crystals of the active materials. Then mechanical agitation created by passing vehicles or by the force of winds may cause these crystals or contaminated dust particles to once again become airborne only to be deposited downwind on sensitive crops.

NOTE: If the weed-control person is aware of such problems, the distinction between slight visual damage and economic damage should be kept in mind. If only a small spot is detected here and there on plants or tree leaves, the damage may be insignificant; no real commercial damage has been done. However, if widespread discoloration, defoliation, or some other form of plant damage occurs, seriously affecting the sensitive crop, the drift may then be considered a serious problem.

It is this latter kind of drift damage that causes deep concern and that may result in legal actions to recover losses. Drawing the fine line between two kinds of damage is difficult, considering both the emotions and the profit motives likely to be involved. So it should be clear that in herbicide application, every precaution must be taken to avoid any form of material transfer to sensitive areas.

Swath Displacement

A rather widespread misconception has led to viewing as 'drift' the movement of offending material across a fence line and into an adjacent sensitive crop when the wind is blowing in the direction of the crop. Usually, movement of this kind involved damage for a distance of only perhaps 150–200 feet. A classic example of such short-distance movement caused severe damage to grape vineyards adjoining a railroad right-of-way some years ago when railroad workers sprayed weeds along the right-of-way. Such short-distance movement of rather high concentrations of active material is not properly the same 'drift' that may do damage at substantial distance. In such cases, the wind has merely moved the swath application downwind a short distance, and this can be more accurately defined as *swath displacement*, essentially a mechanical process of literally moving the normal spray droplets with the wind. Classic drift, on the other hand, depends largely upon a different mechanism involving smaller droplets.

Microweather

From the above descriptions, it will be seen that one prime element controlling drift is air. Hence, microweather—or the precise air movement, temperature, and humidity at the plant level and above the crop in the immediate application area and in nearby areas likely to be affected—is the controlling factor. The overall weather pattern for a county or larger area of a state may actually be substantially different from the immediate environment at crop level. Hence, the applicator must examine these extremely localized conditions and not be led astray by the more general weather report that would be given for the region.

Temperature and Relative Humidity

Temperature and relative humidity have significant effects on the evaporation rates of water mixes, but, as a practical matter where application work to be done is extensive and the time element critical, these factors may not normally be considered, even though temperature limits may be specified. Other factors affecting spray-droplet movement have more immediate effects, which in turn may be modified by temperature.

Temperature Inversion

This condition of the immediate atmosphere in the crop area can present the greatest drift hazard to nearby sensitive crops. A typical inversion occurs early in the morning although it can also occur at other times. During the night, especially on a clear night, the ground radiates warmth to the cooler sky. The air above, however, may retain a large portion of its daytime heat. As dawn approaches, the air at ground level will be

cool and as the air temperature is measured progressively upward, it will prove progressively warmer and then, further upward, will decline continually to higher altitudes. This, in effect, creates a warm-air blanket or barrier above the crop, effectively holding the lower air and its spray-droplet load near the ground and below the level of highest temperature. This spray-contaminated air can move laterally at a low level allowing the small spray droplets in relatively high concentration to drop slowly and to eventually be deposited on some sensitive crop. This condition can produce the most severe drift damage.

Lapse

The opposite of inversion is a condition called 'lapse.' It can be most easily described by referring to the same early morning field condition that generated an inversion. As the day progresses, the sun warms the ground, raising its temperature until it is warmer than the air above it. From that time on, the highest temperature in the system is at the ground, and, progressing upward, the temperature is found to decline with increase in altitude. This situation allows droplets light enough to float in the air to be lofted upward. As they move upward with warm air rising from the ground, horizontal wind movement may cause mixing, and the droplets may finally fall to earth, but because of the wide scattering during the lapse, they will probably be so widely dispersed as to cause no visual or economic damage.

Sensitive Area Considerations

Considering the effects of microweather, it becomes clear that whenever sensitive crops exist nearby, the wise chemical applicator will make the effort to analyze the microweather situation in order to determine an appropriate spray time. An adverse application condition at 7:00 a.m. can suddenly yield to ideal conditions a short time later. Smoke layers have commonly been used as excellent indicators, and where environmental controls permit, they can be used to identify an inversion. An alternative method would be to identify the nature of time, temperature, and wind conditions.

Spray Nozzles

The previous discussion of chemical drift points toward a critical factor that may have a major influence on drift. That factor is droplet size. Ideally, of course, applications would be made with all droplets the same size, small enough for good coverage yet large enough to minimize drift. Much research and development have gone into making nozzles or other droplet generators that can do this. Substantial progress has been made, but unfortunately, the commercially available single-drop-size generator remains to be developed.

Some nozzles do a better job than others. Typical fan, offset, and cone nozzles disperse a wide range of droplet sizes. Newer developments such as the "raindrop" and the "low pressure" (LP) nozzles have narrowed the range of drop size. The applicator must be alert and not drawn into a web of wishful thinking that he is now using a "drift-proof" nozzle. Some rotary devices are advertised as producing a very narrow range of droplet sizes, which they can do under very specific conditions of fluid flow and velocity, but the fact remains that even these release a percentage of droplet sizes smaller than desirable minimums.

Wind-shear Effect

While a great deal of attention is given to the selection of nozzles to obtain proper droplet size, the manner of installation of those nozzles on an aircraft can substantially change the desired droplet diameter. If the nozzle discharges parallel to air flow as the aircraft moves forward, most droplets will be the size intended unless aircraft speed is too great. If the nozzle is rotated downward so that the angle of the discharge stream to the airflow approaches 90 degrees, the air will shear off the stream, effectively breaking it up to produce a much smaller droplet spectrum, thus increasing the potential for drift.

Spray-nozzle Wear

In general, the applicator must be aware that the flow of chemicals through nozzles wears them out. Nozzle life varies, depending upon the hardness and other physical characteristics of the nozzle material and upon the abrasiveness of the chemical flowing through the nozzle. Sooner or later, however, the orifice size will become enlarged and misshapen, and at that point an increased material flow can seriously affect sprayer calibration, and, as the size of the orifice increases, the amount of material being applied may surpass the safety limits. The result may be over-application with the possibility of residue problems, costly waste of spray material, and assorted crop damage.

The applicator must recognize the vital need for periodic inspection and calibration to assure that the material is applied uniformly and in the right amount. It is important to know that nozzles of different materials and spraying different formulations wear at different rates, but that eventual wear is inevitable. One cannot go merrily on his way expecting to get by without periodic calibration simply because he believes the nozzles are hardened stainless and therefore could "never wear out."

SAFETY IN AERIAL CONDITIONS

Weed-control personnel may have various assignments that involve them in aerial operations. Some may work full time in this area while others,

as advisers or chemical-company representatives, only become involved occasionally. The "full-timer" may be well-trained, but the occasional visitor may be more subject to hazard. Some basic rules apply for both safety and good relations with aerial operators.

Rotors and Propellers

Helicopter rotors and airplane propellers rotate at such high speeds that they may be invisible. When working near such aircraft, the greatest danger lies in lack of attention. Anyone concentrating on a problem or involved in conversation may be momentarily distracted and, in the process, inadvertently step into a turning rotor or propeller. The main helicopter rotor can turn close enough to the ground to strike a person; it has happened. The power generated by such blades is hard to believe. The small tail rotor, even though most are guarded, spins at a speed that makes it invisible.

These dangers are so deadly that one simply must remember that, when an engine is running, the responsibility for personal safety lies strictly with those on the ground. Everyone should *stay clear*, maintain awareness of the rotating part above all other matters, and not permit any discussion, argument, or technical matter to result in any form of distraction that could lead to a serious accident.

There is one variation on these rules that is equally important: *Never turn your back on an approaching aircraft*. The typical agricultural aircraft moves on the ground in the tail-down position. This substantially reduces the pilot's vision directly in front of the plane, and it is up to people on the ground to consider that the pilot cannot see anyone in front of the plane and to stay clear.

Aircraft Crashes

A person nearby when such a disaster occurs may be in a position to save the pilot's life with proper action. On the other hand, ignorance and improper action on the part of those present at a crash scene have been known to contribute to the pilot's death. The right procedures to follow are those outlined in the California Agricultural Aircraft Association's manual, *Ground Crew—This Is Your Life*; they are adapted as follows:

1. *Do not panic*. You can't think clearly or help the pilot unless you are calm.
2. Get the fire extinguisher out of your truck and go immediately to the plane.
3. If the plane is on fire:
 - Try to get the pilot out and move him to a safe distance.
 - Put out the fire with your extinguisher unless it is too dangerous to do so.

4. Check the pilot's clothing to see if he has been splashed with pesticides. If so, and he isn't seriously injured, help him to the nearest water and wash him several times with soap.

5. If the pilot isn't seriously injured, take him to a hospital or a doctor. *Be sure* to tell them if he has been exposed to pesticides and the name of that pesticide. Take a label with you if it is available. The doctor can use its instructions.

6. If the pilot is seriously injured or unconscious, *do not move him* from the plane except to save his life from fire.

7. Check to see if he is strangling or choking; check for bleeding. When there is severe bleeding, make a pad out of a clean cloth and hold it very firmly with your hand directly over the cut. Keep pressure on the cut, and raise the wounded area if you can. As soon as practical, go or have someone go to the nearest phone to call for an ambulance or a doctor. Be sure to tell them where you are.

8. If you can't get an ambulance, phone your company immediately and tell them what has happened and *exactly* where the injured pilot is.

9. Follow the ambulance to the hospital or doctor's office to make certain they know the pilot has been exposed to pesticides. If they give him a shot of morphine for pain and he has phosphate poisoning it could kill him.

Good Manners

Anyone working around or visiting an agricultural aircraft should know that a pilot depends on the proper functioning of his aircraft for his work and his life. Most pilots take great pride in their aircraft and may deeply resent the actions of any visitor who mars or damages them.

There is very little reason for a casual visitor to climb on the plane. If it is necessary to do so, the proper walkways are clearly marked (usually, a black, non-slip surface). The area outside of the walkway is strictly off-limits and not intended to support the weight of a person. Also, contact with or damage to any other part of the aircraft must be avoided. The pilot will appreciate attention to such correct procedures which may prevent future problems or accidents.

Cleaning and Rinsing

During normal flight operations it is easiest to flush the aircraft tank, to fill it partially with clean water, and then fly back over the treated area to spray the rinse water on the crop. This technique reduces the problem of disposal of rinse water at the landing strip. Of course, it will be more economical to dump at the strip, and therein lies a problem.

Disposal of rinse water and possible spilled chemical must be done in a manner that meets state regulations, and, in particular, must be done

so that there is no possibility of contamination of groundwater. This always requires good judgment, respect for regulations, and a good understanding of the possibility of severe consequences of improper dumping.

Waste disposal is the concern of regulating agencies. The regulations that apply essentially require the system to be capable of preventing contamination of groundwater and streams. Because of the great variety of soil conditions and operation requirements, no further details will be gone into here. Anyone involved in such rinse-water disposal should contact the local county agricultural commissioner for assistance.

When Cleaning Aircraft or Equipment Remember:

- That it is contaminated from the use of chemicals.
- To wear chemical-resistant boots and gloves, and other protective clothing.
- To be sure to have plenty of ventilation.
- That it can be dangerous to steam-clean equipment because steam can change chemicals into vapor that can be absorbed and inhaled more readily.
- To keep clear of steam, splash, and vapor.
- After washing equipment—bathe.
- To use plenty of soap and water, or solvent.
- After washing equipment—change clothes. Do not wear clothing that may be contaminated.

Maintenance Hazards

Spray systems normally have plugged or worn nozzles at some time. Since such systems have been carrying chemicals, the person working on one should consider that a chemical may be present and should, therefore, take the necessary precautions to avoid contact with it when removing parts. The temptation to blow backward through a plugged nozzle should be overcome, since, naturally, any part which has been in contact with a poison should not be put to one's lips. Nozzles are delicate with finely machined orifices and so must be cleaned with something soft, a wooden toothpick, or soft brass wire—not a pocketknife!

If for some reason welding must be done, the system must be absolutely clean to prevent the formation of dangerous gases. Any welder should also be aware of the dangers of welding on galvanized material and the consequent dangerous fumes.

Wear Protective Equipment When You Handle Chemicals

The correct procedures for handling chemicals are covered in detail in regulations too extensive to include here. Also, from time to time, new

developments make it necessary to revise the regulations. If agricultural chemicals are to be handled, the county agricultural commissioner should be contacted for copies of the latest regulations and any other instructions he may wish to give regarding such activities.

Special Rules for Flagmen

1. Wear protective clothing and equipment: Coveralls, hard hat, and respirator when exposed to vapors, spray mist, or dust.
2. Know what chemical is being used. Read the label before going to the field.
3. Keep as much spray and dust off yourself as possible. *Always* start flagging on downwind side and flag into the wind—never into the drift.
4. If possible, never flag under power lines or near fences. If the plane should cut the wires or snag the fence, the trailing wires could hurt you.
5. In applying Category I materials, where possible flag in the field adjacent to the one you are treating.
6. When you arrive at the field to be treated, warn people who are in or around that field that an aircraft is going to treat the field. Ask them to stay out of the field and away from the drift.
7. Park vehicles off the highway or road in such a manner that they will not block traffic.
8. Watch the airplane at all times—but especially when it is approaching you. Do not turn away, or you won't be able to tell how close it is.
9. After the airplane is lined up in your position, move at least the distance of the next pass, but *do not turn your back* on an approaching airplane.
10. Stay at the field location until the pilot has *completed* the job. In case of an accident, you may be able to help the pilot.

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REGULATION AND REGISTRATION

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Two federal statutes provide the authority to regulate pesticides: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and several sections of the Food, Drug, and Cosmetic Act (FDCA). FDCA establishes tolerances of pesticides in food. FIFRA, enacted in 1947 and amended several times, most recently in 1988, states that health and environmental concerns are to be balanced against the benefits of use. It provides for control of pesticides, creates a restricted-use classification for selected pesticides, and permits states to regulate pesticides in a manner consistent with federal requirements.

The regulations for the enforcement of FIFRA are in the Code of Federal Regulations, Protection of Environment, Title 40, Parts 150 to 189. It is the responsibility of the Environmental Protection Agency (EPA) to administer these regulations.

Pesticides cannot be distributed or offered for sale by any person or state unless registered with the EPA. A pesticide is classified for general or restricted use by the EPA. Restricted-use pesticides require more precautions during application than do general-use pesticides.

Changing pest-control needs and increased environmental concerns in different states have increased the states' legislative role in pesticide regulation.

California has adopted additional regulations to meet environmental and safety concerns and needs of the public, farm employees, and farmers. The state has also developed its own restricted-materials list using the following criteria: (1) danger to or impairment of public health; and (2) hazard to farmworkers, crops, and domestic animals and/or subsequent plantings from persistent residues in the soil.

Most herbicides are not as acutely toxic as such insecticides as the organophosphates, but, in laboratory animal studies, a number of them have shown the potential for causing chronic effects if exposure is sufficient. Herbicides are legally classified as pesticides and are subject to federal registration and use requirements.

California also has pesticide worker-safety and restricted-materials regulations to specify safe work practices for employees who mix, load, apply, store, or otherwise handle pesticides or enter treated areas. The work practice regulations are designed to reduce risk during exposure.

It is the responsibility of employers to provide safe workplaces for employees and to ensure that employees follow safe work practices. Employees are required to be aware of pesticide-worker safety hazards and pesticide safety regulations applicable to all activities they perform.

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The California Department of Food and Agriculture (CDFA) is the lead agency for enforcing federal and state pesticide laws and regulations. The county agricultural commissioner is responsible for enforcing all federal, state, and county regulations and is the local source of information on these regulations. For example, prior to obtaining a permit to use any restricted pesticide, applicants must contact the agricultural commissioner in the county where use is anticipated and confirm with the commissioner that the applicants have knowledge of regulations and safety precautions, and answer any additional questions pertaining to the proposed use.

LABEL REQUIREMENTS AND INTERPRETATION

All labels are required to contain information specified by FIFRA and the regulations in Title 40 (Section 162.10). The label must clearly show the following: the product trade name; the name of the registrant; net weight or measure of contents; the EPA registration number; the registration number of the formulation plant; an ingredient statement giving the name and percentage by weight of the active ingredient and the percentage of inert ingredients; the use-classification (general or restricted); directions for use; warnings or precautionary statement.

The warnings and precautionary statements deal with questions of toxicology and environmental, physical, or chemical hazards. A toxicity category is assigned to every pesticide product according to the criteria in the following table of possible acute effects:

Hazard indicators	Toxicity categories			
	I	II	III	IV
Oral LD ₅₀	Up to and including 50 mg/kg	From 50 thru 500 mg/kg	From 500 thru 5000 mg/kg	Greater than 5000 mg/kg
Inhalation LC ₅₀	Up to and including 0.2 mg/liter	From 0.2 thru 2 mg/liter	From 2 thru 20 mg/liter	Greater than 20 mg/liter
Dermal LD ₅₀	Up to and including 200 mg/kg	From 200 thru 2000 mg/kg	From 2000 thru 20,000 mg/kg	Greater than 20,000 mg/kg
Eye effects	Corrosive, corneal opacity; not reversible within 7 days	Corneal opacity; reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 days	No irritation
Skin effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours

LD₅₀ or LC₅₀ is the dose or concentration required to kill 50% of the test animal population.

The signal word DANGER is required for any pesticide meeting one or more of the criteria under Toxicity Category I. Toxicity Category II

materials require the signal **WARNING**, while Categories III and IV use the signal word **CAUTION**.

Both federal and state laws and regulations require that pesticides be used in accordance with the labeling, and this includes following the safety precautions on the label. However, it is impossible to include detailed instructions necessary for adequate safety procedures for all of the combinations of circumstances that may occur. For example, one might assume that the most hazardous vapors or spray mist occur in confined spaces indoors, but hazardous conditions may occur in open areas if there is no wind.

The period of greatest hazard in any pesticide-applications procedure is usually during pouring and mixing operations in which splashing and spilling may occur on either skin or clothing. To protect the eyes from splashes or spills when handling liquid pesticides, a face shield is superior to goggles because of the personal comfort and complete face protection afforded. However, when handling powders or dusts, goggles are preferred since particles will rise under a face shield. Respiratory protection is needed whenever volatile, toxic liquid pesticides or toxic dusts and powders are handled.

Skin protection for workers is the most difficult problem associated with the application of pesticides. In hot weather, the use of clothing impervious to pesticides may create a hazard of heat prostration greater than that of pesticide exposure. Recent innovations in designing protective clothing with new porous fibers may alleviate this problem in the future.

CDFA regulations require an employer to base the training for employees on information given on the label, in the regulations, and in appropriate Pesticide Safety Information leaflets available through the county agricultural commissioner's office. They also require that employees be provided with protective clothing and devices to mitigate exposure hazards shown on the labeling. Protective-device requirements found on a label must be interpreted relative to the real or potential hazard of the situation. For example, if the hazard has been mitigated by such measures as enclosed cockpit, boom location, remote-control operation, or closed pumping system, the operator is not required to take the protective measures stated on the label. The CDFA publishes "Guidelines for Interpreting Pesticide Label Statements for Protective Device Requirements," pertaining to their interpretation of labels and protective device requirements. This information may be obtained from the CDFA or your agricultural commissioner.

Closed Systems

Hand pouring has been found to be the most hazardous activity involved in the handling of highly toxic liquid pesticides and has resulted in seri-

ous human illnesses. A "closed system" removes a pesticide from its original container, rinses the emptied container, and transfers the pesticide and rinsate through connecting hoses, pipes, and couplings that are sufficiently tight to prevent exposure of any person to the pesticide or rinse solution. Some closed systems also measure the amount of chemical needed, completely eliminating human exposure to the chemical. Use of such systems is required when using Toxicity Category I liquid pesticides.

Respiratory Protection

One requirement of a respiratory-protection program is to first assess the inhalation hazards to which workers will be exposed. The assessment process involves first gathering information concerning the toxicity of the pesticide(s); determining whether it will be a gas, dust, vapor, or mist exposure; accurately estimating the concentrations around the worker; and noting any special precautionary requirements determined through the latest research.

When hazardous concentrations of pesticides cannot be removed from the worker's breathing zone, or when emergency protection against occasional or brief exposure is needed, the employer must provide, and the employee must use, approved respiratory equipment.

Each employee must be instructed and trained by management in the need, use, sanitary care, and limitations of any respiratory equipment he may have to use.

Several organizations and individuals are available to answer questions arising from specific instances. Among them are:

- Safety equipment retailers (see local telephone directory Yellow Pages).
- California Department of Food and Agriculture.
- County Agricultural Commissioner.

Worker Health and Safety

There are both state and federal laws and regulations pertaining to worker health and safety. California has had laws and regulations in place for agricultural workers since the mid-1970s. These regulations, titled "The California Code for Regulations Pertaining to Worker Safety," are updated as required to ensure a safe agricultural working environment in California. California's existing regulations specify that when there is a conflict between state and federal law, the most restrictive requirement applies. In addition to providing information pertaining to safe work practices and associated responsibility, California's regulations include recommendations for re-entry intervals to ensure that workers are not exposed to toxic concentrations of pesticides. All Toxicity Category I

pesticides require one-day re-entry periods, while other individual pesticides carry intervals appropriate to their toxicity, residual properties, and crop/use patterns. With the exception of Toxicity Category I materials, there are currently no re-entry intervals listed for herbicides.

First Aid and Decontamination Procedures

A person who becomes ill while working with pesticides should stop work immediately, notify the supervisor or a fellow employee of the situation, and take whatever measures are necessary to eliminate continued pesticide exposure. The ill person should go to a source of fresh air, remove work clothing, shower completely (including washing the hair), and change into clean clothing. (If shower facilities are not immediately available, the person should remove all clothing immediately and use whatever water source is available to clean the body.) If the person collapses suddenly while working with pesticides, he or she should be removed from the pesticide use area immediately and given whatever resuscitation may be necessary.

Persons caring for the ill worker should be aware that a sudden collapse may be due to a heart attack or other medical emergencies not related to pesticide exposure. Rescuers should also be careful not to contaminate themselves while caring for a victim whose skin and clothing may be saturated with pesticide chemicals. Once the ill person has been resuscitated (if necessary) and decontaminated, he should be transported immediately to the nearest emergency-medical-care facility. It is very important to supply the physician or emergency room personnel where the victim is taken with as much information as possible regarding the circumstances under which the illness began. It is also useful to provide the examining physician with the name of the product or products the victim was handling or was exposed to, and pertinent information about it/them, including labels and antidotes if known.

REGISTRATION OF HERBICIDES IN CALIFORNIA

Products submitted to the California Department of Food and Agriculture for possible registration must also hold current federal (EPA) registration or be in an EPA review process. Prior to federal registration, the registrant must submit data according to Title 40, Section 162.8 of the federal regulations. These data requirements include, but are not limited to, the following:

- Efficacy
- General chemistry (composition and analytical method for the technical and formulated products)
- Environmental chemistry (field stability, degradation data, etc.)

- Hazard to humans and domestic animals (acute toxicity, subacute and chronic toxicity, first-aid and diagnostic information, foliar residue, and exposure information)
- Hazard to nontarget organisms (toxicity to fish and avian species)

The data submitted determine the registerability and the use-classification (signal word and necessity, if any, for restricted material). Requirements of some or all of these data may be waived if the registrant submits evidence that the properties of the product are fundamentally different from those considered by the EPA in establishing data requirements.

Before the state of California registers a herbicide for use, it must have a federal registration as a pesticide. California requires at least the same data as that submitted to the EPA. California may also require additional data if the properties of the product warrant such action under the state's unique use-conditions or laws. Exact data requirements may be found in the California Administrative Code, Title 3, Chapter 4. The following is a list of some of the pertinent "California-only" data requirements:

- **Dermal Absorption** (To assess the rate and extent of absorption through the skin as well as the chemical's effect once it enters the body.)
- **Mixer/Loader/Applicator Exposure** (To determine the extent of exposure and the necessity for additional use-precautions.)
- **Medical Management Data** (This information, backed by experimental data, is needed in order to inform physicians of the methods of treatment for overexposure.)
- **Field Re-entry Information** (Dislodgeable-foliar and soil-residue data under California conditions.)
- **Spray Adjuvants—Acute Toxicity** (To assess the potential hazards of use.)
- **Residue-Test Methods** (To have the best possible, fastest method to assure foods comply with residue tolerances.)
- **Efficacy** (Required for all label claims to ensure that the user will get a useful product.)
- **Hazard to Bees** (For products likely to contact apiaries or pollinating bees.)
- **Closed-System Compatibility** (Viscosity information required on all Toxicity Category I pesticides.)
- **Effects on Pest-management Systems** (Required for addition of new crops to label.)
- **Inert-ingredient Hazards** (To assess chronic toxicity of more hazardous inert ingredients.)
- **Volatile Organic Materials** (To evaluate ambient air-quality standards of these materials.)

- **Other Data Upon Request** (This includes, but is not limited to, data on pesticide drift, phytotoxicity, environmental effects, analytical and environmental chemistry, effects from use of two or more products in combination, and contaminants in products.)

In addition, products may be used in California under a Section 5 (experimental use permit) registration, a Section 24(c) (special local need) registration, and/or a Section 18 (emergency) exemption registration. Experimental use permits allow for the development of data. If a pesticide registered for experimental use is applied on food crops, the crop will be destroyed if no food tolerance has been established. A Section 18 exemption may allow the use of an unregistered pesticide when emergency conditions exist. Emergencies can be a pest outbreak with no pesticides registered for that use or alternative method of control available, and where significant economic or health problems will occur. A Section 24(c) registration can allow for the minor use of a particular pesticide when this use is not registered on the label. No pesticide which has been canceled or suspended may be used under a 24(c) registration.

PESTICIDE STORAGE, TRANSPORTATION, AND DISPOSAL

All storage areas should be clean, dry, and well-lighted during use. Storage areas containing pesticides with the signal words DANGER or WARNING on the label must have warning signs posted at all probable directions of approach. These signs should say: "DANGER POISON STORAGE AREA," or some similar warning, and be readable from a distance of 25 feet. Pesticides should be stored only in properly labeled original containers, never in food or beverage containers.

All pesticides should be transported in a secure, upright position, with the opening closed to prevent spillage. All containers must have some form of labeling attached, which should be either the original labeling or with service container labeling as specified by regulations.

Empty unrinsed pesticide containers are considered hazardous waste and must be disposed of in an approved manner. Each emptied container that held less than 28 gallons must be triple-rinsed upon emptying. This rinse solution should be added to the mix tank. Some empty containers may be reconditioned by recyclers approved by the California Department of Health Services. Containers that cannot be reconditioned must be disposed of at a disposal site approved by the Water Resources Control Board. Emptied pesticide containers awaiting disposal or reconditioning should be stored in a locked enclosure and under control of a responsible person.

Storage of pesticide waste products (old materials, unused tank mixes) or emptied containers may require a hazardous waste facility

permit. The Department of Health Services provides information concerning specific requirements.

Outer shipping containers not contaminated with pesticide residues and containers that held dry pesticide formulations shall be disposed of as permitted by state and local regulations. If regulations permit, these containers may be disposed of by burning at the use site. (Always stand upwind from the smoke while burning bags or outer containers.)

Finally, users should contact the county agricultural commissioner who will be familiar with all local requirements pertaining to disposal of pesticide containers.

RECOMMENDATIONS

Of the many regulations that apply to the use of pesticides in California, one of the most important deals with who can give what advice on what chemical to apply and under what circumstances.

In California it is unlawful for any person to act or offer to act as an agricultural pest control adviser without first having secured an agricultural pest control adviser's (PCA) license from the CDFA. Additional information pertaining to the responsibilities of the PCA may be found in Chapter 10. An appropriate B.S. or B.A. degree or applicable college course work plus suitable experience is required of applicants.

Applicants for licensing must elect to be examined for certification in one or more of the following categories:

- Control of insects, mites, and other invertebrates.
- Control of plant pathogens.
- Control of nematodes.
- Control of vertebrate pests.
- Control of weeds.
- Defoliation.
- Plant growth regulation.

Agricultural pest control advisers must put all recommendations concerning any agricultural use in writing. One copy of each written recommendation must be signed, dated, and furnished to the grower. Where a pesticide use is recommended, a copy must also be furnished to the dealer and the applicator. Each written recommendation must include, when applicable, the following:

- The name and dosage of each pesticide to be used or description of method recommended.
- The identity of each pest to be controlled.
- The owner or operator, location, and acreage to be treated.
- The commodity, crop, or site to be treated.
- The suggested schedule, time, or conditions for the pesticide application or other control method.

- A warning of the possibility of damages by the pesticide application that are known to exist.
- The signature and address of the person making the recommendation, the date, and the name of the business that the person represents.

Any other information the CDFA may require such as:

- Total acreage or units to be treated;
- Concentration and volume per acre or other units;
- Worker re-entry interval, if one has been established; preharvest or preslaughter interval; and label restrictions on use or disposition of the treated commodity, by-products, or treated area;
- Criteria used for determining the need for the recommended treatment; and
- Certification that alternatives and mitigation measures that would substantially lessen any significant adverse impact on the environment have been considered, and, if feasible, adopted.

In addition, the recommendation should designate the pest by accepted common name.

LEGISLATIVE CHANGES

In the past few years, a series of administrative and regulatory actions concerning pesticides have been taken by the federal government, and a number of pieces of state and federal legislation and one state initiative have been enacted. These are now having a major impact on which pesticides will be used in California, as well as when and where they will be used. In the mid-to-late 1980s these were being implemented simultaneously; they will significantly affect pesticide use in the 1990s. Several of these are summarized below.

Pesticide Contamination Prevention Act of 1985

The stated purpose of the Pesticide Contamination Prevention Act, enacted by the California Legislature, is to prevent further pesticide contamination of California groundwater which may be used for drinking water. The act requires the CDFA to:

- Collect and analyze environmental fate data on all pesticides registered for agricultural use in California to determine groundwater data gaps and identify and monitor potential contaminants;
- Review any pesticide or related chemical found in groundwater or in soil under certain conditions to determine if that chemical pollutes or threatens to pollute groundwater as a result of legal agricultural use, and take appropriate corrective action when necessary; and

- Compile and maintain a statewide data base of wells sampled for pesticide active ingredients.

Examples of herbicides that are currently being reviewed under this act include atrazine, bromacil, diuron, prometon, and simazine.

Birth Defects Prevention Act of 1984

This required the CDFA to acquire complete study data developed in accord with 1984 EPA federal regulations for general chronic effects, cancer, reproductive effects, teratology, neurotoxicity, and mutagenicity for each of the more than 600 pesticide active ingredients registered. It also required risk assessments that could lead to restrictions or cancellations in accordance with the severity of adverse effects found.

A number of herbicides have had assessment notices to fill data requirements under this legislation. The cost of filling the initial data requirements for each individual pesticide has been estimated at approximately \$3 million. Examples of individual herbicides that have had assessment notices in the range of the aforementioned amount include chloramben, chlorsulfuron, DCPA, oxyfluorfen, and terbacil.

Toxic Air Contaminants Act of 1983

This act requires, among other things, that the Director of Food and Agriculture, in consultation with other agencies and groups, determines the appropriate degree of control measures for pesticides identified as toxic air contaminants. Pesticides, including a number of herbicides (e.g., 2,4-D, bromoxynil, diquat, methyl bromide, and paraquat) are currently under review. Suggested practicable control techniques to prevent an endangerment to the public health include, but are not limited to, the following: label amendments, applicator training, restrictions on use patterns or locations, changes in application procedures, reclassification as a restricted material, and cancellation.

The Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65)

This act is a result of a ballot initiative passed by the people of California. It provides that "no person in the course of doing business shall knowingly and intentionally expose any individual to a chemical known to the state to cause cancer or reproductive toxicity without first giving clear and reasonable warning to such individual," (Health and Safety Code Section 25249.6). Three key issues associated with this act relate to warning, labeling, and discharge requirements. This act also requires the governor to publish each year a current list of chemicals known to the state to cause cancer or reproductive toxicity. A number of pesti-

cides have been listed, many of which are no longer registered for use in California. The only herbicide currently listed is amitrole.

Endangered Species Protection

The EPA is required by current law to regulate the use of pesticides so that a hazard to endangered species (including weeds) is avoided. The EPA has experienced great difficulty in implementing this law. The EPA proposes to make significant progress in this area in the next few years. The first proposals on restriction or non-use of chemicals to accomplish this would have significantly reduced the number of chemicals (including some herbicides) and the areas where they could have been used. As label changes are made and regulations are put into place, the locales and the time of year when some herbicides can be used will be affected by this program.

People who have an interest in continued use of chemical pesticides would do well to become actively involved in supporting enactment and enforcement of laws and regulations that allow continued use of pesticides. Along with this, of course, should go careful attention, so that the environment and the public's health are not adversely affected.

INDIVIDUAL HERBICIDES

There are a number of herbicides that are registered for use in California that have special problems associated with either their toxicity or use. It is not the intent of this section to single out individual products or formulations, but to provide *examples* of individual herbicides that fall into one or more of the aforementioned categories.

Toxicity Related

Toxicity Category I

- Acifluorfen, acrolein, alachlor, benefin, difenzoquat, fluazifop-P, metolachlor, paraquat, and sulfuric acid.

It should be noted that inclusion in Toxicity Category I may be made on the basis of either the actual toxicity of the herbicide, or the toxicity of the inert ingredients included in the formulation (e.g., solvents), or both.

Use Related

Spray and/or Vapor Drift

- 2,4-D, dicamba, and MCPA—drift to sensitive broadleaved row, vegetable, tree, and vine crops.

- Chlorsulfuron and sulfometuron—drift to sensitive tree and vine crops.
- Glyphosate and paraquat—drift to young (emerging) seedlings, especially vegetable crops, and also drift to established, sensitive broadleaved and grassy species.
- Propanil—drift to sensitive tree crops (e.g., prunes).

Soil Contamination

- Bromacil—off-site problems associated with tree roots extending into treated areas (e.g., walnuts).
- Crop rotation—label restrictions regarding the planting back of crops following registered applications (e.g., simazine and trifluralin).
- Noncrop herbicides (e.g., bromacil, chlorsulfuron, dicamba, prometon, sulfometuron, and tebuthiuron)—off-site movement to sensitive crops and carryover (residues) in soil.

Surface Water Contamination

- Rice herbicides (e.g., bentazon, molinate, and thiobencarb)—use in relation to residue levels in surface water.